

PATENT ABSTRACTS OF JAPAN

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(21)Application number : 04-270375 (71)Applicant : CHIYATANI SANGYO KK
OHTSU TIRE & RUBBER
CO LTD :THE
(22)Date of filing : 08.10.1992 (72)Inventor : KOJIMA TAKESHI
NINOMIYA SHINPEI

(54) SURFACE ILLUMINATION DEVICE

(57)Abstract:

PURPOSE: To increase brightness while maintaining the uniformity over the entire surface of a light diffusion plate without increasing the thickness over the entire part of a light reflection plate by devising the surface shape of the light diffusing plate.

CONSTITUTION: This surface illumination device is constituted by having a transparent plate 2, a reflection plate 4 laminated on the rear surface of this transparent plate 2 and the light diffusing plate 6 laminated on the front surface of the transparent plate 2, providing an irregular reflection layer 3 between the transparent plate 2 and the reflection plate 4 and disposing a light source 8 for irradiating the inside of the transparent plate 2 with light on the lateral end face of the transparent plate 2. Plural dotty projections 7 which are regularly arranged and have light condensing and diffusing functions are formed on the surface of the above-mentioned light diffusion plate 6 on the side opposite from the transparent plate 2. Then, the light transmitted

through the transparent plate 2 is effectively condensed by the respective dotted projections 7 and the light condensed in such a manner is efficiently diffused and, therefore, the brightness is made higher than heretofore while the desired uniformity is maintained without increasing the total thickness.

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CLAIMS

[Claim(s)]

[Claim 1] While having the transparency plate 2, the reflecting plate 4 which carries out a laminating to the rear face of this transparency plate 2, and the optical diffusion plate 6 which carries out a laminating to the front face of said transparency plate 2 and forming the scattered reflection layer 3 between said transparency plates 2 and said reflecting plates 4 Area-light equipment which carries out the description of forming condensing arranged regularly and two or more dot-like projections 7 with a diffusion function to an anti-opposed face with said transparency plate 2 in said optical diffusion plate 6 in the area-light equipment which has arranged the light source 8 which

irradiates light in this transparence plate 2 in the side edge side of said transparence plate 2.

[Claim 2] Area-light equipment according to claim 1 which makes the dot-like projection 7 formed in the optical diffusion plate 6 the shape of a semi-sphere.

[Claim 3] Claim 1 which is arranging alternately two or more dot-like projections 7 formed in the optical diffusion plate 6, and area-light equipment given in two.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to area-light equipment and the area-light equipment used for a liquid crystal display etc. in detail.

[0002]

[Description of the Prior Art] As it is indicated by JP, 58-38186, U, for example and is conventionally shown in drawing 7 and drawing 8 as this kind of area-light equipment. While forming in one field of the transparence plate A the scattered reflection layer B which consists of the fine spot of a large number to which scattered reflection of the light is carried out and making the rear face of said transparence plate A carry out the laminating of the reflecting plate C to the letter of adhesion by using this scattered reflection layer B as a rear face The front face of said transparence plate A is made to carry out the laminating of the optical diffusion plate D which has the irregularity to which a configuration changes from an unspecified crepe pattern to one field to the letter of adhesion, the light sources E and E are arranged in the both-sides side face of said transparence plate A, and what illuminated uniformly and brightly the whole surface of said optical diffusion plate D is known.

[0003]

[Problem(s) to be Solved by the Invention] By the way, when the area-light equipment constituted as mentioned above is used for a liquid crystal display, An operator needs to enable it to recognize liquid crystal displays, such as **** expressed all over a liquid crystal display plate, a numeric value, and a pattern, with uniform vision,

therefore it crosses all over a liquid crystal display plate. By homogeneity It is requested that the brightness more than predetermined is maintained. And moreover Not only in when seeing liquid crystal displays expressed to said liquid crystal display plate, such as **** and a numeric value, from a right angle to the screen core of said display plate Even when seeing to the upper and lower sides and right and left to said screen core within the limits of a predetermined ***** angle of visibility (generally 60 degrees), what can be recognized with uniform vision is desired.

[0004] However, with the area-light equipment by which the conventional proposal is made, it migrated to all the front faces of a liquid crystal display plate, and sufficient high brightness could not be obtained, maintaining regularity, but there was a problem which is not made to recognize a liquid crystal display easily with uniform vision in the range of an angle of visibility.

[0005] Moreover, although two or more sheet laminating of said optical diffusion plate is carried out or what performed crimp processing to the front flesh side of an optical diffusion plate, and formed the crepe pattern is proposed as an approach of solving the above problem In any case, condensing effectiveness is low, and the problem which still runs short of the brightness in the range of an angle of visibility remains, and cannot perform recognition with uniform vision enough over all the front faces of a liquid crystal display plate.

[0006] In this invention, when this problem was pursued, it traced that a difficulty was in the optical diffusion plate D which carries out a laminating to the front face of said transparence plate A. That is, although it has a certain amount of condensing diffusion since this optical diffusion plate D performs crimp processing and makes it the crepe pattern so that regularity may be obtained, there is no regular condensing function, therefore there is much unevenness, and a condensing operation also has it, and it traces that brightness runs short, and invents paying attention to an optical diffusion plate.

[inadequate]

[0007] This invention aims at offering the area-light equipment which can make brightness high on the whole surface of an optical diffusion plate, without devising the shape of surface type of an optical diffusion plate, and the thickness of the whole equipment becoming thick, in order to solve the above-mentioned trouble.

[0008]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, while this invention is equipped with the transparence plate 2,

the reflecting plate 4 which carries out a laminating to the rear face of this transparence plate 2, and the optical diffusion plate 6 which carries out a laminating to the front face of said transparence plate 2 and forms the scattered reflection layer 3 between said transparence plates 2 and said reflecting plates 4 In the side edge side of said transparence plate 2, two or more dot-like projections 7 which have condensing arranged regularly and a diffusion function in an anti-opposed face with said transparence plate 2 in said optical diffusion plate 6 were formed in the area-light equipment which has arranged the light source 8 which irradiates light in this transparence plate 2.

[0009] Moreover, as for the dot-like projection 7 formed in said optical diffusion plate 6, it is desirable to form in the shape of a semi-sphere.

[0010] Moreover, as for two or more dot-like projections 7 formed in said optical diffusion plate 6, arranging alternately is desirable.

[0011]

[Function] Since the dot-like projection 7 which has condensing which plurality described above, and a diffusion function in an anti-opposed face with the transparence plate 2 of said optical diffusion plate 6 was arranged regularly and formed Since the light which was made to condense effectively the light which has passed said transparence plate 2 by said dot-like projection 7, and condensed can be diffused When the brightness in the range of an angle of visibility can be made high, therefore it applies to a liquid crystal display plate, maintaining regularity, recognition with uniform vision can be easily performed over all the front faces of this liquid crystal display plate.

[0012] Moreover, when forming said dot-like projection 7 in the shape of a semi-sphere, while better condensing is attained according to the lens effectiveness, diffusion of the light in each projection 7 will be performed efficiently, and on the whole, brightness can be raised more, maintaining regularity.

[0013] moreover, said each dot-like projection 7 -- since the consistency of length, width, and said dot-like projection 7 occupied in the whole area since it sets aslant and is moreover mostly made to homogeneity at the minimum can be increased for spacing during each projection 7 by arranging alternately, on the whole, condensing and diffusion can be performed good, and improvement in brightness is raised further.

[0014]

[Example] Drawing 1 shows a part of cross section of the area-light equipment of this invention. The transparence plate 2 of 4-5mm thickness which consists mainly of acrylic resin, The reflecting plate 4 which

carries out a laminating to the letter of adhesion through the spot 31 which forms the scattered reflection layer 3 which carries out a postscript all over the rear face of this transparence plate 2, The 1st light diffusion plate 5 which becomes a letter of adhesion from the polycarbonate which carries out a laminating, polyester resin, etc. on the front face of said transparence plate 2, Form a light guide plate 1 with the 2nd light diffusion plate 6 which has the description of this invention, and the light sources 8 and 8 of an incandescent lamp, a fluorescent light, etc. are arranged to the both-ends side of this light guide plate 1. It constitutes so that the light which irradiates in said transparence plate 2 and carries out incidence into this transparence plate 2 may illuminate the light from said light source 8 on said 2nd light diffusion plate 6 whole surface.

[0015] In the above configuration in addition, said scattered reflection layer 3 It forms in the rear face which is an opposed face with said reflecting plate 4 of said transparence plate 2. This scattered reflection layer 3 A majority of said fine spots 31 whose height is about 30 micrometers, for example are printed so that a specific pattern may be drawn by screen-stencil etc. with the white coating of gloss **** which mixed the minute glass bead. It is made to carry out scattered reflection of a part of light which carries out incidence into said transparence plate 2 from said light source 8. In this case, although it is desirable to make it the shape of a semi-sphere, other configurations are sufficient as it, and homogeneity distribution is sufficient as it, although a spot consistency may be made to become dense as the configuration of said spot 31 keeps away to said light sources 8 and 8.

[0016] Moreover, although said 1st light diffusion plate 5 is an optical diffusion plate in the conventional example from which a configuration equips the front face used as the anti-opposed face of said transparence plate 2 with the irregularity of an unspecified crepe pattern, and the whole serves as opalescence and especially this 1st light diffusion plate 5 is not required for it, using, when improving regularity is desirable.

[0017] Next, said 2nd light diffusion plate 6 which is the description of this invention is explained. This 2nd light diffusion plate 6 forms two or more dot-like projections 7 which have condensing arranged regularly and a diffusion function in an anti-opposed face with said transparence plate 2 using resin sheets, such as polycarbonate resin and polyester resin, like the 1st light diffusion plate 5.

[0018] the die pressing according [this dot-like projection 7] to this embossing roll using an embossing roll -- carrying out -- the example

which was fabricated and was shown in drawing 1 thru/or drawing 3 -- the diameter of about 40 micrometers -- it presupposed that it is hemispherical, and like drawing 3 , it was alternate and a majority of each [these] dot-like projections 7 were arranged regularly.

[0019] When it is desirable at the point that the thickness of a light guide plate 1 can be stopped and fabricates using an embossing roll so that thickness including the dot-like projection 7 of said 2nd light diffusion plate 6 is thin, it is set to 100-200 micrometers. Moreover, when a hemispherical diameter is set to 40 micrometers, as for the pitch of said dot-like projection 7, considering as 40-micrometer pitch is desirable, but even if it makes it larger than 40-micrometer pitch, it does not interfere. Moreover, although between the dot-like projections 7 which adjoin as shown in drawing 2 may be fabricated in the shape of flatness when making it larger than 40-micrometer pitch, it is good also as a reverse R configuration which follows said dot-like projection 7.

[0020] When a deer is carried out and incidence of the light is carried out into said transparence plate 2 from said light source 8, in the light guide plate 1 constituted as mentioned above light Said each spot [in / it goes on carrying out total reflection within said transparence plate 2, and / in this light / said transparence plate 2] 31 When a formation location is reached, Reflect irregularly by, or hit said reflecting plate 4 directly and it reflects. this spot 31 -- passing -- said reflecting plate 4 side of said transparence plate 2 -- coming out -- said each spot 31 -- Repeat refraction reflection, and in the account transparence plate 2 of back to front, incidence is carried out and it spreads at homogeneity at said 1st light diffusion plate 5. Furthermore, light diffuses from this 1st light diffusion plate 5, and it results in said 2nd light diffusion plate 6, and is efficiently condensed with this 2nd light diffusion plate 6, and the condensed light diffuses every dot-like projection 7, and said 2nd light diffusion plate 6 whole surface is brightly illuminated by homogeneity.

[0021] Incidentally, when compared about the regularity and the brightness of the light guide plate 1 which carried out the laminating of the 2nd light diffusion plate 6, and constituted it, the light guide plate 5, i.e., said 1st light diffusion plate, of said 1st example of this invention, and the conventional light guide plate which carried out the two-sheet laminating of said 1st light diffusion plate 5, the measurement result shown in Table 1 and 2 was obtained.

[0022] The same thing is being used for the comparison data of these light guide plates except said 2nd light diffusion plate 6, respectively. The magnitude of 5.7mm and the whole is 206mm wide and 149mm (the

magnitude of an effective light-emitting part) long about the total thickness of each light guide plate. As the two-point broken line shown in drawing 4 shows, the thing of die length of 205mm, the diameter of 3.0mm, and a 5W input is used for said light source 8 by the long side 2 LGT type as being 192mm wide and 144mm long.

[0023] And as shown in drawing 4 , in nine places at which axes of ordinate Y1, Y2, and Y3 and axes of abscissa X1, X2, and X3 are distributed to nine front faces in the core and periphery of each light guide plate, i.e., a light guide plate, so that spacing may become equal, respectively, and each [these] XY shaft crosses them, the brightness seen from a perpendicular direction to said light guide plate is measured. In addition, the measuring instrument to be used is TOPCON. BM-7 (TOPCON CORP. make) is used.

[0024] It is [0025] when the measurement result of the brightness about the light guide plate 1 of the 1st example is shown in Table 1.

[Table 1]

<div><div>×</div><div>—</div></div>

[0026] (unit: Becoming cd/m²), average luminance is 2354 cd/m² in 88% of regularity. It became.

[0027] In addition, it is asking for regularity at (the minimum value of measured value) / (maximum of measured value) x100%.

[0028] Next, it is [0029] when the measurement result of the brightness about the conventional light guide plate is shown in Table 2.

[Table 2]

<div><div>×</div><div>—</div></div>

[0030] (unit: Becoming cd/m²), average luminance is 2071 cd/m² in 84% of regularity. It became.

[0031] From the above result, the light guide plate 1 of this invention is understood [while regularity is the same (it is improving a little in the measurement result) mostly, it is moreover raised about 11.4% in average luminance and the regularity more than predetermined is maintained compared with the conventional thing, and] that brightness

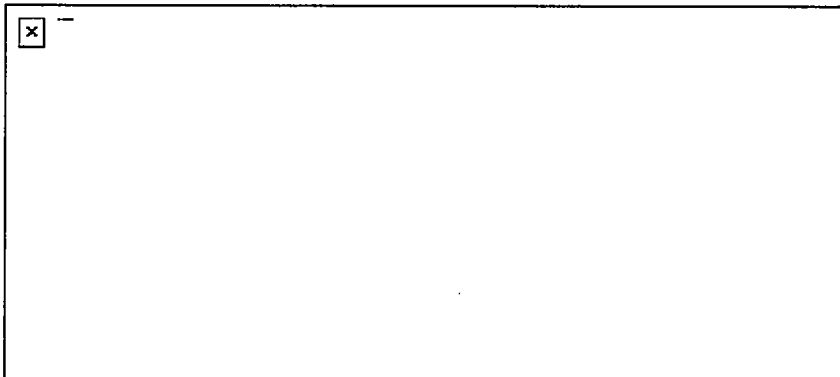
is improving on the whole, making total thickness the same.

[0032] Moreover, the result of having changed and measured the include angle which tries to receive this light guide plate 1 in the brightness in the light guide plate 1 of this invention is shown below.

[0033] In drawing 4 , this light guide plate 1 is received in the center section of said light guide plate 1. First, centering on the direction of a right angle (location of the front face of a light guide plate 1 to 90 degrees) Each brightness when setting the brightness when inclining to the end-face side which arranges a for the brightness in each include angle when inclining the include angle to see to a longitudinal-direction, i.e., end face which is not arranging said light source 8, side, and is arranging the vertical direction 8, i.e., said light source, for the include angle to see to b is shown in Table 3.

[0034]

[Table 3]



[0035] When applying to a liquid crystal display plate generally, an angle of visibility is made into 60 degrees, what a liquid crystal display can recognize good with uniform vision to the location seen from a right angle to the screen core of said liquid crystal display plate within limits which were able to be shifted by a unit of 30 degrees in the direction of four directions is required, and the angle of visibility in Table 3 is within the limits of the 90 above mentioned include angles thru/or 60 degrees.

[0036] Moreover, the measuring point of the brightness in Table 3 is brightness 2208 cd/m² of the center position which is the intersection of the axis of ordinate Y2 of drawing 4 , and an axis of abscissa X2, i.e., the center position shown by **, and was shown in Table 1. Brightness 2211 cd/m² in the 90-degree location in Table 3 And 2216 cd/m² Although it differs somewhat, these are measurement errors and a theory top will be in agreement.

[0037] Therefore, although brightness will fall a little to the above

mentioned upper and lower sides and the above mentioned angle-of-visibility limitation of a longitudinal direction if the brightness is seen in the angle-of-visibility range (90 - 60 degrees in Table 3) in the measurement result of Table 3 Within the limits of 40 angles of visibility (90 - 70 degrees in Table 3) (location of the front face of a light guide plate to 70 degrees), i.e., the angle of visibility usually used, there is almost no fall of brightness and predetermined brightness is obtained in the range of an angle of visibility.

[0038] In the example shown in drawing 1 thru/or drawing 3 , that desired regularity was obtained and the brightness has improved, making it the total thickness same like the above as the conventional example Since the dot-like projection 7 of a large number formed all over said 2nd light diffusion plate 6 is made hemispherical From having structure with which each [these] dot-like projection 7 carried out the operation of a lens, and the small lens was innumerably located in a line It is thought that it is because the light which could condense efficiently the light which passed said transparency plate 2 and the 1st light diffusion plate 5 by the lens effectiveness, and condensed in the range of an angle of visibility can be efficiently diffused in each dot-like projection 7.

[0039] Moreover, said dot-like projection 7 in this invention may not be limited in the shape of a semi-sphere as mentioned above, and may be formed truncated **** or in the shape of a truncated cone, and may be formed in a cylinder or a prismatic form.

[0040] One example is shown in drawing 5 and 6 among those. Drawing 5 and the example shown in 6 are what was formed in the shape of a truncated hexagon-head spindle, after opposed face spacing set to 40 micrometers at the maximum and makes the tilt angle of each side about 35 degrees, forms the circular crevice 71 with a diameter of 7.5 micrometers in a top-face center section, and arranges it regularly alternately like the 1st example which showed each [these] dot-like projection 7 to drawing 1 thru/or drawing 3 .

[0041] Said each dot-like projection 7 in this example can also improve brightness, without thickening total thickness, being able to fabricate with an embossing roll, and the same effectiveness as the 1st example being acquired by said each dot-like projection 7, and being able to obtain predetermined regularity.

[0042] In addition, improvement in brightness is obtained as compared with the case where it does not form, what said circular crevice 71 raised the optical diffuser efficiency in a top face, raises brightness, and formed this crevice 71 is circular, and also it is desirable to

consider as the cross-section configuration and analog of said dot-like projection 7.

[0043] Moreover, in the above configuration, the height of said dot-like projection 7 can be set up freely, and can also set up the pitch during each dot-like projection 7 corresponding to desired brightness, and it is not necessary to necessarily arrange it alternately.

[0044] Moreover, although the laminating of the 2nd light diffusion plate 6 which has said dot-like projection 7 to this 1st light diffusion plate 5 was carried out in said 1st example using the 1st light diffusion plate 5 of a crepe pattern, it is not necessary to use the 1st light diffusion plate 5. However, it can be made higher than the case where only said 2nd light diffusion plate 6 is used without using said 1st light diffusion plate 5 for brightness, by using said 1st light diffusion plate 5.

[0045]

[Effect of the Invention] Condensing which arranged the light guide plate of this invention regularly to the anti-opposed face with said transparence plate 2 in said optical diffusion plate 6 as explained above, Since two or more dot-like projections 7 with a diffusion function were formed and the light which was made to condense effectively the light which has passed said transparence plate 2 by said each dot-like projection 7, and carried out **** condensing can be diffused efficiently Brightness can be made higher than before, without thickening total thickness, maintaining desired regularity. Therefore, when it applies to a liquid crystal display plate, recognition with uniform vision can be easily performed over all the front faces of this liquid crystal display plate.

[0046] Moreover, when forming said dot-like projection 7 in the shape of a semi-sphere, while better condensing is attained according to the lens effectiveness, diffusion of the light in each projection 7 will be performed efficiently, and on the whole, brightness can be raised more, maintaining regularity.

[0047] moreover, said each dot-like projection 7 -- since the consistency of length, width, and said dot-like projection 7 occupied in the whole area since it sets aslant and is moreover mostly made to homogeneity at the minimum can be increased in spacing during each projection 7 by arranging alternately, on the whole, the condensing and diffusion can be performed more to fitness, and much more improvement in brightness is attained.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The area-light equipment of this invention is a notching sectional view a part.

[Drawing 2] The 2nd light diffusion plate in the 1st example is a notching sectional view a part.

[Drawing 3] The 2nd light diffusion plate in the 1st example is a notching plan a part.

[Drawing 4] The explanatory view showing the measuring point at the time of measuring the brightness of the light guide plate in the 1st example, and the conventional light guide plate.

[Drawing 5] The optical diffusion plate in the 2nd example is a notching sectional view a part.

[Drawing 6] The optical diffusion plate in the 2nd example is a notching plan a part.

[Drawing 7] The sectional view of conventional area-light equipment.

[Drawing 8] Conventional area-light equipment is a notching perspective view a part.

[Description of Notations]

2 Transparence Plate

3 Scattered Reflection Layer

4 Reflecting Plate

6 Optical Diffusion Plate (2nd Light Diffusion Plate)

7 Dot-like Projection

8 Light Source

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(71)出願人 391019821

茶谷産業株式会社

大阪府大阪市中央区東心斎橋1丁目4番11号

(71)出願人 000103518

オーツタイヤ株式会社

大阪府泉大津市河原町9番1号

(72)発明者 児島 健

大阪府富田林市藤沢台4丁目6番17号

(72)発明者 二宮 心平

大阪府堺市赤坂台3丁目9-12-408

(74)代理人 弁理士 津田 直久

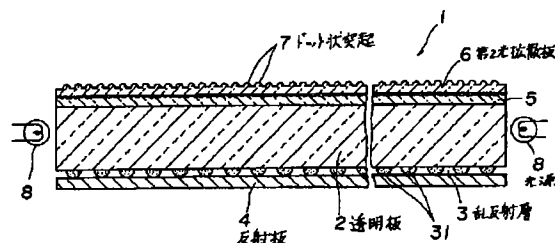
(54)【発明の名称】 面照明装置

(57)【要約】

【目的】光拡散板の表面形状を工夫して、導光板全体の厚みが厚くなることなく、光拡散板の全面において均斉度を保持しながら、輝度を高くする。

【構成】透明板2と、透明板2の裏面に積層する反射板4と、透明板2の表面に積層する光拡散板6とを備え、透明板2と反射板4との間に乱反射層3を設けると共に、透明板2の側端面に、透明板2内に光を照射する光源8を配置した面照明装置において、光拡散板6における透明板2との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起7を形成する。

【効果】透明板2を通過してきた光を各ドット状突起7で有効に集光させられ、かつ、斯く集光した光を効率よく拡散させることができるので、所望の均斉度を保ちながら、また、総厚を厚くすることなく、従来よりも輝度を高くすることができる。



【特許請求の範囲】

【請求項1】透明板2と、該透明板2の裏面に積層する反射板4と、前記透明板2の表面に積層する光拡散板6とを備え、前記透明板2と前記反射板4との間に乱反射層3を設けると共に、前記透明板2の側端面に、該透明板2内に光を照射する光源8を配置した面照明装置において、前記光拡散板6における前記透明板2との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起7を形成していることを特徴する面照明装置。

【請求項2】光拡散板6に形成するドット状突起7を半球状にしている請求項1記載の面照明装置。

【請求項3】光拡散板6に形成する複数のドット状突起7を千鳥状に配設している請求項1及び2記載の面照明装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、面照明装置、詳しくは液晶表示等に用いる面照明装置に関する。

【0002】

【従来の技術】従来、この種の面照明装置としては、例えば実開昭58-38186号公報に開示され、また、図7及び図8に示すように、透明板Aの一方の面に光を乱反射させる多数の細かい斑点から成る乱反射層Bを形成して、この乱反射層Bを裏面として前記透明板Aの裏面に反射板Cを密着状に積層させると共に、前記透明板Aの表面に、一方の面に形状が不特定の梨地模様から成る凹凸を有する光拡散板Dを密着状に積層させて、前記透明板Aの両側側面に光源E、Eを配設して、前記光拡散板Dの全面を均一に、かつ、明るく照明するようにしたものが知られている。

【0003】

【発明が解決しようとする課題】ところで、以上のように構成する面照明装置を液晶表示に用いる場合、液晶ディスプレイ板の全面に表現する文言、数値、パターン等の液晶表示を、オペレータが均一な視覚で認識できるようにする必要があり、そのために液晶ディスプレイ板の全面にわたり均一で、かつ、所定以上の輝度が維持されることが要望されており、しかも、前記液晶ディスプレイ板に表現する文言や数値などの液晶表示を、前記ディスプレイ板の表示面中心に対し直角方向から見る場合だけでなく、前記表示面中心に対し上下及び左右に所定角ずらせた視野角（一般には60度）の範囲内で見られる場合でも均一な視覚で認識できることが望まれている。

【0004】ところが、従来提案されている面照明装置では、液晶ディスプレイ板の全表面にわたり、均斉度を保ちながら十分な高輝度を得ることができず、液晶表示を視野角の範囲において均一な視覚で容易に認識させられない問題があった。

【0005】また、以上の問題を解消する方法として、前記光拡散板を複数枚積層したり、光拡散板の表裏にし

ぼ加工を施して梨地模様を形成したものの提案されているが、何れの場合も集光効果が低く、依然として視野角の範囲での輝度が不足する問題は残存しており、液晶ディスプレイ板の全表面にわたり均一な視覚での認識が十分行えないのである。

【0006】本発明では、この問題を追求したところ、前記透明板Aの表面に積層する光拡散板Dに難点があることをつきとめた。即ち、この光拡散板Dは、均斉度が得られるようにしぼ加工を施して梨地模様としているため、ある程度の集光拡散作用を有しているが、規則正しい集光機能はなく、そのためむらが多いし、また、集光作用も不十分で輝度が不足することを突き止め、光拡散板に着目して発明したものである。

【0007】本発明は、上記問題点を解決するために、光拡散板の表面形状を工夫して、装置全体の厚みが厚くなることなく、光拡散板の全面において輝度を高くすることができるとする面照明装置を提供することを目的とする。

【0008】

【課題を解決するための手段】本発明は上記目的を達成するために、透明板2と、該透明板2の裏面に積層する反射板4と、前記透明板2の表面に積層する光拡散板6とを備え、前記透明板2と前記反射板4との間に乱反射層3を設けると共に、前記透明板2の側端面に、該透明板2内に光を照射する光源8を配置した面照明装置において、前記光拡散板6における前記透明板2との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起7を形成したのである。

【0009】また、前記光拡散板6に形成するドット状突起7は半球状に形成することが好ましい。

【0010】また、前記光拡散板6に形成する複数のドット状突起7は千鳥状に配設することが好ましい。

【0011】

【作用】前記光拡散板6の透明板2との反対向面に複数の前記した集光、拡散機能をもつドット状突起7を規則的に配列して形成したので、前記透明板2を通過してきた光を前記ドット状突起7で有効に集光させられ、かつ、集光した光を拡散させることができるので、均斉度を保ちながら視野角の範囲での輝度を高くすることができ、従って、液晶ディスプレイ板に適用した場合、この液晶ディスプレイ板の全表面にわたり均一な視覚での認識を容易に行うことができるのである。

【0012】また、前記ドット状突起7を、半球状に形成する場合には、レンズ効果によりより良好な集光が可能となると共に、各突起7での光の拡散が効率よく行われることになり、均斉度を保ちながら全体的により輝度を向上させることができる。

【0013】また、前記各ドット状突起7……を千鳥状に配設することにより、各突起7間の間隔を縦、横、斜めにおいてほぼ均一にしかも最小限にできるので、全体の面積に占める前記ドット状突起7の密度を増すことが

できるので、全体的に集光及び拡散を良好に行うことができ、輝度の向上を一層高められるのである。

【0014】

【実施例】図1は本発明の面照明装置の横断面の一部を示したものであって、4～5mm厚の主としてアクリル樹脂から成る透明板2と、この透明板2の裏面全面に後記する乱反射層3を形成する斑点31を介して密着状に積層する反射板4と、前記透明板2の表面に密着状に積層するポリカーボネートやポリエステル樹脂などからなる第1光拡散板5と、本発明の特徴を有する第2光拡散板6とにより導光板1を形成し、この導光板1の両端面に白熱電球、蛍光灯などの光源8、8を配置して、前記光源8からの光を前記透明板2内に照射し、該透明板2内に入射する光が、前記第2光拡散板6全面において照明するように構成したものである。

【0015】尚、以上の構成において、前記乱反射層3は、前記透明板2の前記反射板4との対向面である裏面に形成したものであって、この乱反射層3は、微小のガラスビーズを混入したツヤ消しの白色塗料によりスクリーン印刷などで特定のパターンを描くように細かい例えば高さが30 μ m程度の前記斑点31を多数印刷して、前記光源8から前記透明板2内に入射する光の一部を乱反射させるようにしているのである。この場合、前記斑点31の形状は、半球状にするのが好ましいが、他の形状でもよいし、また、前記光源8、8に対し遠ざかるに従って斑点密度を密になるようにしてもよいが均一分布でもよい。

【0016】また、前記第1光拡散板5は、前記透明板2の反対向面となる表面に形状が不特定の梨地模様の凹凸を備え、全体が乳白色となっている従来例での光拡散板であって、この第1光拡散板5は特に必要でないが、均斉度を向上する上で用いるのが好ましい。

【0017】次に本発明の特徴である前記第2光拡散板6について説明する。この第2光拡散板6は、第1光拡散板5と同様ポリカーボネート樹脂やポリエステル樹脂などの樹脂シートを用い、前記透明板2との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起7を形成したものである。

【0018】このドット状突起7は、例えばエンボスロールを用い、該エンボスロールによる型押しにより成形するのであって、図1乃至図3に示した実施例では直径約40 μ mの半球状とし、かつ、これら各ドット状突起7を、図3のように千鳥状で規則的に多数配設したのである。

【0019】前記第2光拡散板6のドット状突起7を含む厚さは、薄いほど導光板1の厚さを抑えられる点で好ましいのであって、エンボスロールを用いて成形する場合には例えば100～200 μ mとなる。また、前記ドット状突起7のピッチは、半球状直径を40 μ mとした場合、40 μ mピッチとするのが好ましいが、40 μ m

ピッチより大きくしても差し支えない。また、40 μ mピッチより大きくする場合、図2に示したように隣接するドット状突起7間を平坦状に成形してもよいが、前記ドット状突起7に連続する逆アーチ形状としてもよい。

【0020】しかして、以上のように構成した導光板1において、前記光源8から前記透明板2内に光を入射させると、光は、前記透明板2内で全反射しながら進行し、この光が前記透明板2における前記各斑点31……の形成位置に至ったとき、該斑点31を通過して、前記透明板2の前記反射板4側に出て、前記各斑点31……により乱反射したり、前記反射板4に直接あたって反射したりして、屈折反射を繰り返し、その後前記透明板2内に入射されて前記第1光拡散板5に均一に行きわたり、さらに、この第1光拡散板5から光が拡散されて、前記第2光拡散板6に至り、該第2光拡散板6により効率よく集光され、かつ、集光された光が各ドット状突起7ごとに拡散されるのであって、前記第2光拡散板6全面が明るく均一に照明されるのである。

【0021】因に本発明の前記第1実施例の導光板、つまり、前記第1光拡散板5に、第2光拡散板6を積層して構成した導光板1と、前記第1光拡散板5を2枚積層した従来の導光板との均斉度及び輝度について比較してみると、表1及び表2に示す測定結果が得られた。

【0022】これら導光板の比較資料は、それぞれ前記第2光拡散板6以外は同じものを使用しており、各導光板の総厚を5.7mm、全体の大きさが、横206mm、縦149mm（有効発光部の大きさは、図4に示す2点破線で示すように横192mm、縦144mmである）として、前記光源8を長辺2灯式で、長さ205mm、直径3.0mm、5ワット入力のものを使用する。

【0023】そして、図4に示すように、各導光板の中心及び周辺部における9箇所、つまり導光板の表面に、縦軸Y1、Y2、Y3と、横軸X1、X2、X3とをそれぞれ間隔が均等となるように配分してこれら各XY軸が交わる9箇所において、前記導光板に対し垂直方向から見る輝度を測定するのである。尚、使用する測定器は、TOPCON BM-7（トプコン社製）を使用している。

【0024】第1実施例の導光板1についての輝度の測定結果を、表1に示すと、

【0025】

【表1】

	Y1	Y2	Y3
X1	2494	2493	2392
X2	2270	2208	2192
X3	2282	2421	2433

【0026】（単位：cd/m²）となり、均斉度88%で、平均輝度は、2354cd/m²となった。

【0027】尚、均斉度は（測定値の最小値）／（測定値の最大値）×100%で求めている。

【0028】つぎに、従来の導光板についての輝度の測定結果を表2に示すと、

【0029】

【表2】

	Y1	Y2	Y3
X1	2203	2238	2188
X2	1888	1980	1897
X3	2024	2115	2128

【0030】（単位： cd/m^2 ）となり、均斉度84%で、平均輝度は、 $2071\text{cd}/\text{m}^2$ となった。

【0031】以上の結果から、本発明の導光板1は、従来のものに比べて均斉度はほぼ同じ（測定結果では若干向上している）で、しかも、平均輝度において約11、

4%向上させられ、所定以上の均斉度を保ちながら、また、総厚を同じにしながら全体的に輝度が向上しているのが分かる。

【0032】また、本発明の導光板1における輝度を該導光板1に対し見る角度を変えて測定した結果を次に示す。

【0033】まず、図4において、前記導光板1の中央部において、該導光板1に対し直角方向（導光板1の表面から90度の位置）を中心に、見る角度を左右方向、即ち、例えば、前記光源8を配設していない端面側に傾いていったときの各角度における輝度をa、また、見る角度を上下方向、即ち、例えば前記光源8を配設している端面側に傾いていったときの輝度をbとしたときの各輝度を表3に示す。

【0034】

【表3】

	a	b
90度	2211 cd/m^2	2216 cd/m^2
70度	2015 cd/m^2	2058 cd/m^2
60度	1729 cd/m^2	1751 cd/m^2
50度	1332 cd/m^2	1396 cd/m^2
40度	855 cd/m^2	1059 cd/m^2

【0035】一般に液晶ディスプレイ板に適用する場合、視野角は60度とされ、前記液晶ディスプレイ板の表示面中心に対し直角方向から見る位置に対し、上下左右方向に30度ずつずらせた範囲内で、均一な視覚で液晶表示が良好に認識できることが要求されるのであって、表3における視野角は前記した角度90度乃至60度の範囲内である。

【0036】また、表3における輝度の測定位置は、図4の縦軸Y2、横軸X2の交点、つまり、⑤で示した中心位置であって、表1に示した中心位置の輝度 $2208\text{cd}/\text{m}^2$ と表3における90度位置での輝度 $2211\text{cd}/\text{m}^2$ 及び $2216\text{cd}/\text{m}^2$ とは多少異なるが、これらは測定誤差であって、理論上は一致することになる。

【0037】従って、表3の測定結果での視野角範囲（表3における90～60度）で、その輝度をみまると、前記した上下、左右方向の視野角限界では輝度が若干低下しているが、視野角（表3における90～70度）、つまり、通常使用される視野角40度（導光板の表面から70度の位置）の範囲内では、殆ど輝度の低下がないのであって、視野角の範囲において所定の輝度が得られるのである。

【0038】図1乃至図3に示した実施例において、以上のごとく従来例と同じ総厚にしながら、所望の均斉度が得られて、その輝度が向上できたのは、前記第2光拡散板6の全面に形成した多数のドット状突起7を半球状としているから、これら各ドット状突起7がレンズの作用をし、小さなレンズが無数に並んだ構造となっていることから、前記透明板2及び第1光拡散板5を通過した光をレンズ効果で効率よく集光でき、かつ、視野角の範囲に集光した光を各ドット状突起7において効率良く拡散させることができることによるものと考えられる。

【0039】また、本発明における前記ドット状突起7は、以上のように半球状に限定するものでなく、截頭角錐または截頭円錐状に形成してもよいし、また、円柱や角柱状に形成してもよい。

【0040】そのうち一つの実施例を図5及び6に示す。図5、6に示した実施例は、截頭六角錐状に形成したもので、対向面間隔が最大で例えば $40\mu\text{m}$ とし、各辺の傾斜角を例えば35度程度とした上で、頂面中央部に例えば直径 $7.5\mu\text{m}$ の円形凹部71を形成し、これら各ドット状突起7を図1乃至図3に示した第1実施例と同様千鳥状に規則的に配設したものである。

【0041】この実施例における前記各ドット状突起7

も、例えばエンボスロールにより成形できるのであって、前記各ドット状突起7により、第1実施例と同様の効果が得られ、所定の均斉度を得られながら、また、総厚を厚くすることなく輝度を向上できるのである。

【0042】尚、前記円形凹部71は、頂面での光拡散効率を高め、輝度を向上させるもので、この凹部71を形成したものは、形成していない場合に比較して輝度の向上が得られるのであって、円形その他、前記ドット状突起7の横断面形状と相似形とするのが好ましい。

【0043】また、以上の構成において、前記ドット状突起7の高さは自由に設定することができ、各ドット状突起7間のピッチも所望の輝度に対応して設定することができるし、必ずしも千鳥状に配設する必要はない。

【0044】また、前記第1実施例では、梨地模様の第1光拡散板5を用いて、この第1光拡散板5に前記ドット状突起7を有する第2光拡散板6を積層したが、第1光拡散板5は用いなくともよい。しかし、前記第1光拡散板5を用いることにより、輝度を前記第1光拡散板5を使用せずに前記第2光拡散板6のみを使用する場合よりも高くすることができるのである。

【0045】

【発明の効果】以上説明したように、本発明の導光板は、前記光拡散板6における前記透明板2との反対向面に規則的に配列した集光、拡散機能をもつ複数のドット状突起7を形成したから、前記透明板2を通過してきた光を前記各ドット状突起7で有効に集光させられ、かつ、斯く集光した光を効率よく拡散させることができるので、所望の均斉度を保ちながら、また、総厚を厚くすることなく、従来よりも輝度を高くすることができるのである。従って、液晶ディスプレイ板に適用した場合、この液晶ディスプレイ板の全表面にわたり均一な視覚での認識を容易に行うことができるのである。

【0046】また、前記ドット状突起7を、半球状に形成する場合には、レンズ効果によりより良好な集光が可能となると共に、各突起7での光の拡散が効率よく行われることになり、均斉度を保ちながら全体的により輝度を向上させることができる。

【0047】また、前記各ドット状突起7……を千鳥状に配設することにより、各突起7間の間隔を縦、横、斜めにおいてほぼ均一にしかも最小限にできるので、全体の面積に占める前記ドット状突起7の密度を増大できるので、全体的にその集光及び拡散をより良好に行うことができ、輝度のより一層の向上が可能となる。

【図面の簡単な説明】

【図1】本発明の面照明装置の一部切欠断面図。

【図2】第1実施例における第2光拡散板の一部切欠断面図。

【図3】第1実施例における第2光拡散板の一部切欠上面図。

【図4】第1実施例における導光板と従来の導光板との輝度を測定する際の測定位置を示す説明図。

【図5】第2実施例における光拡散板の一部切欠断面図。

【図6】第2実施例における光拡散板の一部切欠上面図。

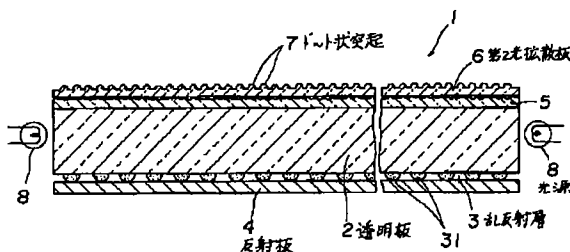
【図7】従来の面照明装置の断面図。

【図8】従来の面照明装置の一部切欠斜視図。

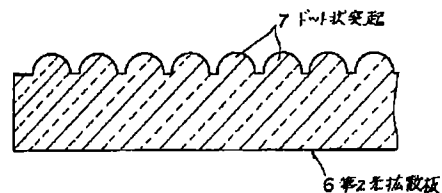
【符号の説明】

- 2 透明板
- 3 乱反射層
- 4 反射板
- 6 光拡散板（第2光拡散板）
- 7 ドット状突起
- 8 光源

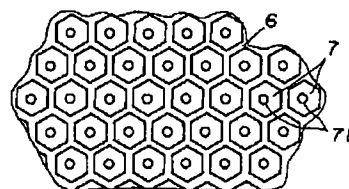
【図1】



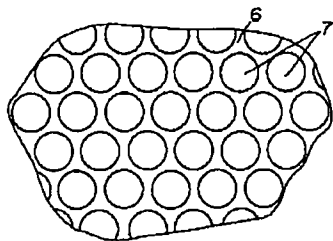
【図2】



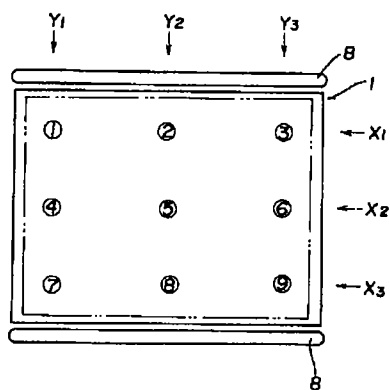
【図6】



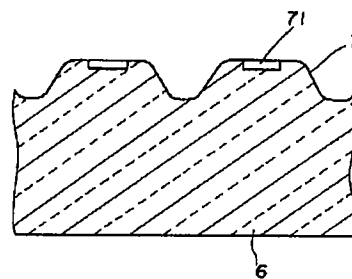
【図3】



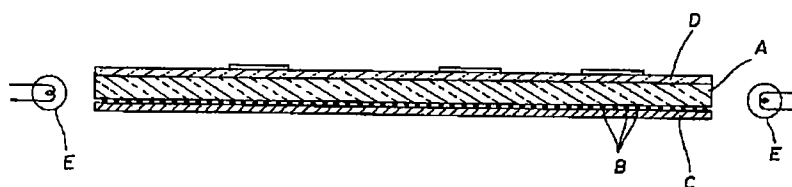
【図4】



【図5】



【図7】



【図8】

